

# PHOTOPOLYMERIZATION

## XIII MEMS FAB

### B. Clean Room Photopoly. LENS

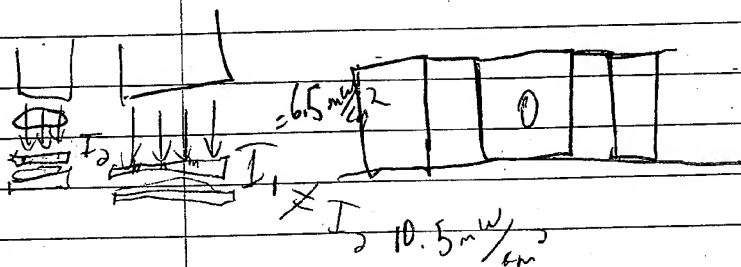
mole %	Ceraset(g)/Actual	(40%g)/Actual	ITX(g)/Actual
1.25	7 / 7.0010	0.0272 / 0.0274	0.0246 / 0.0245

#### METHOD

EXPOSE TIME: 26 min SPIN SPEED: 750 rpm 15 sec

RINSE ACETONE 1000 RPM 5-10 sec

ID	SUBSTRATE	LENS	HEIGHT	OBSERVATION
Si-1	Si	No		
Si-2	Si	YES		
Si-3	Si	<del>YES</del>		
Si-4	Si	<del>YES</del>		
GRAPHITE		No		



Reads ~~15.5~~ 20 on dial  
21 & 46.5 for  
Graphite  
Good for both  
Graphite

13 419 on dial for Si

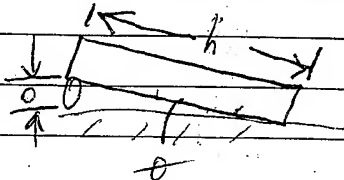
(61)

## PHOTOPOLYMERIZATION

### XIII MEMS FAB

#### C. DEPTH OF CURE

Glass ~~and~~ trench dimensions



$$\sin \theta = \frac{D_p}{h}$$

$$\theta = \sin^{-1} \left( \frac{D_p}{h} \right)$$

EXPOSE TIME: 20 min

(10)

#### D. ~~BU8~~ w/Teflon AF molds

- 1) ~~Etch~~ Etch Si w/48% HF (Oxide Layer)
- 2) SPIN 530 rpm (15 sec)  $\text{Si} 8-10$
- 3) Hot plate  $165^\circ\text{C}$  (8 min) Burst any bubbles
- 4) BAKE 20 min
- 5) EXPOSE 20 sec
- 6) Post Exposure Bake  $50^\circ\text{C}$  hotplate 1 min
- 7) Develop 8 min

#### E. CASTING w/Teflon AF

TEFLON AF

- 1) SPIN for 30 sec @ 1500 rpm
- 2) Bake on hot plate  $45^\circ\text{C}$  for 5 min.
- 3) " " " "  $145^\circ$  for 5 min
- 4) " " " "  $245^\circ$  for 10 min - let cool
- 5) Dice & Fill
- 6) From filling,

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# PHOTOPOLYMERIZATION

## XV THIO-ENE ADDITION

$$\frac{\text{MW Ceraset}}{\text{Funct. grp.}} = \frac{333.694}{3} = 111.23 \frac{\text{g/mol}}{\text{Funct. group}}$$

$$\frac{\text{Thiol ene}}{\text{Funct. grp.}} = \frac{488.66 \text{ g/mol}}{4} = 122.165 \frac{\text{g/mol}}{\text{Funct. group}}$$

$$\frac{111.23}{122.165} = 0.91 \frac{\text{g Ceraset}}{\text{g Thiol}}$$

$$1.51159 \text{ g Ceraset} = 0.91 \times \text{g Thiol}$$

$$1.51159 \text{ g Ceraset} = X \text{ g Thiol}$$

$$0.91$$

$$1.66109 \text{ g} = \text{Thiol} \times$$

$$\text{MDA} = 0.02138 \text{ g}$$

IR PEAKS

	Region 1	Region 2	
THIOL	(2616, 2460)	(1606, 1581)	C=C

Region

- ANALYSIS

Thiol - Areas with shoulder - 41%

Area without shoulder - 39%

ENE - AREA - (63%) (37% ~~left~~ conversion)

hols still left (122)

116

# PHOTOPOLYMERIZATION

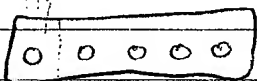
1598-1525

1612 1573

FTIR - Mono Thiol ADDITION

$$\frac{\text{MW Ceraset} - 333.694}{\text{Fcn. Group } 3} = \frac{111.23 \text{ g/mol}}{\text{FUNCTIONAL GROUP}}$$

$$\frac{\text{Mono Thiol} - 146.30}{\text{FCN. GROUP } 1} = \frac{146.30 \text{ g/mol}}{\text{FCN GROUP}}$$



$$\frac{111.23 \text{ g/mol}}{146.3 \text{ g/mol}} = \frac{0.76 \text{ g Ceraset}}{\text{g Mono Thiol}}$$

$$X \text{ g Monothiol} = \frac{.05401 \text{ g Ceraset}}{0.76} = .071$$

$$X_g = .07236$$

2 wt% Benzophenone

$$\frac{X_g \text{ BP}}{X_g \text{ BP} + X_g \text{ Sol}} = 2\%$$

$$X_g \text{ BP} = .02(X_g \text{ BP} + X_g \text{ Sol})$$

$$X_g \text{ BP} + 0.02 X_g \text{ BP} = .02 X_g \text{ Sol}$$

$$X_g \text{ BP} = \frac{.02 \cdot X_g \text{ Sol}}{1.02} = .00248$$

$$X_g \text{ BP} = .00202$$

(125)

PHOTOPOLYMERIZATION

C=C PEAK

1608.37 1583.3

Thiol PEAK

2597.7 2514.76

SERIES SETUP

Conset

How Thick

426

## PHOTOPOLYMERIZATION

### FTIR MONO THIOL ADDITION

$$X_g \text{ Cerset} = .05831$$

$$Y_g \text{ Monothiol} = \frac{X_g \text{ Cerset}}{0.76} = .07678g$$

$$Y_g \text{ (ACTUAL) MONOTHIOL} = .07678g \quad Z_{\text{solution}} = 0.12978$$

(Benzophenone)

$$X_g \text{ BP} = \frac{0.02 \cdot Z_{\text{solution}}}{1.02} = .0025g$$

$$X_g \text{ BP} = .00279$$

Pure BP-monothiol 1.5px

THIOL (2889, 2527) (2589, 2527)

C=C (1609, 1585) (1609, 1564)

OBSERVATIONS: SPECTRA UNCLEAR

INCREASE THIOL By 3

Decrease BP wt% to 0.5

- ANALYSIS

More peak shoulders

66% CONVERSION

% CONVERSION

C=C

Thiol

Get a shot  
of this

C

## PHOTOPOLYMERIZATION

### FTIR MONOTHIOLE ADDITION

$$X_g \text{ Carboxyl} = 0.05268g$$

$$Y_g \text{ Monothiol} = \frac{0.05268g}{0.56 \times 7} = 0.0693g \times 3 = 0.2079g$$

$$Y_g \text{ Monothiol (ACTUAL)} = 0.20881g$$

$$Z_g \text{ Solution} = 0.26149$$

$$X_g \text{ BP} = \frac{0.005 \cdot Z_g \text{ solution}}{1.005} = 0.00130g$$

$$X_g \text{ BP (ACTUAL)} = 0.00180g$$

$$\text{Thiol} (2592.9, 2500.3) \quad (2593.8, 2501.3)$$

$$\text{C=C} (1610.3, 1584.26) \quad (1610.3, 1584.26)$$

### ANALYSIS

C=C 82% CONVERSION v 100% All  
CONVERSION 31% THIOL PEAK 6/9 Thiols  
Reacted